Iowa Department of Transportation

SPECIAL PROVISIONS

FOR

FIBER OPTIC DEPLOYMENT

At various locations within the Council Bluffs Interstate Systems (CBIS), along South Expressway from IA-92/US 275 to City of Council Bluffs Fleet Maintenance Garage, and in Downtown Council Bluffs

IMN-029-3(150)54--0E-78
Effective Date:
August 19th, 2015

	I hereby certify that this engineering document was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. Mark D. Pohlmann 07/28/2015 Mark D. Pohlmann, PE Date License number 17009 My license renewal date is December 31, 2015. Pages or sheets covered by this seal: Entire Document

THE STANDARD SPECIFICATIONS, 2012 EDITION, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

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PART I
GENERAL REQUIREMENTS

This project involves furnishing, installing, splicing, terminating, and testing the fiber optic cables at various locations as shown on the project plans. The Contractor shall perform all work necessary to meet the requirements for this fiber optic deployment project in accordance with these special provisions and the project plans. This part of the special provisions consists of the general provisions necessary when furnishing and installing the fiber optic cables required by this project.

The Contractor shall furnish and install tracer wire, fiber optic termination shelves, adaptor panels, fiber optic splice closures with splice trays and storage baskets, fiber optic splices with protective sleeves, UPC/SC factory installed pigtails and all necessary accessories to make the fiber optic cable systems fully functioning.

The Contractor shall not take advantage of any apparent error, discrepancy or omission in the plans or specifications. Upon discovery of such an error, discrepancy or omission, the Contractor shall notify the Engineer immediately. The Engineer will then make such corrections or interpretations as necessary to fulfill the intent of the plans and specifications.

Materials or work described in words which, so applied, have known technical or trade meaning shall be held to refer to such recognized standards.

Figured dimensions on the plans shall be taken as correct but shall be checked by the Contractor before starting construction. Any errors, omissions, or discrepancies shall be brought to the attention of the Engineer and the Engineer's decision thereon shall be final. Correction of errors or omissions on the drawings or specifications may be made by the Engineer when such correction is necessary for the proper execution of the work.

1.1 Related Specifications and Standards

A. General

The work as detailed on the plans for the ITS Infrastructure Installation shall be completed in accordance with the plans, special provisions and all other Contract Documents including the documents listed below. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete project.

1. 2012 edition of the Standard Specifications of the Iowa Department of Transportation with GS-12005
2. Latest published Supplements to Standard Specifications
3. Specifications of the Underwriter's Laboratories, Inc.
4. National Electric Code
5. Telecommunications Industry Association/Electronic Industries Alliance
6. Manual on Uniform Traffic Control Devices
7. Iowa DOT Flagger's Handbook
8. Iowa DOT Standard Road Plans Manual

1.2 Local Requirements

A. General

Comply with any special requirements and limitations identified in the Plans.

B. Coordination of Work

The Iowa DOT CBIS program currently carries out multiple projects in the vicinity of this project as noted in Tab 111-01 on sheet J.01 of the plans. The anticipated start/finish dates and duration of these projects are shown in the table below. The CBIS program will assist in coordination with these projects that are under construction at the same time as this project. The Contractor for this project shall assign a responsible staff member that will work with the Iowa DOT and the CBIS program on decisions regarding order of work and scheduling as needed throughout the duration of this project.

Project	Description	Anticipated Start	Anticipated Finish	Duration (Month)
IM-NHS-080-1(386)0--03-78	Lighting	06/2015	06/2017	24
IM-NHS-080-1(387)0--03-78	Traffic Signs	06/2015	06/2017	24
IM-NHS-080-1(388)2--03-78	Bridge	06/2015	06/2017	24
IMN-080-1(452)1--0E-78	ITS Conduit Infrastructure	08/2015	10/2015	2
IM-NHS-029-3(102)48--03-78	Grade and Pave	04/2015	05/2017	22
IM-NHS-029-3(104)48--03-78	Signals and ITS	04/2015	05/2017	22
IM-NHS-080-1(370)4--03-78	Grading	07/2014	03/2016	20
IM-NHS-080-1(385)2--03-78	Grade and Pave; ITS	06/2015	06/2017	24
ITS Statewide Contract	ITS Maintenance	On-going	-	-

The Contractor shall furnish and install fiber optic cable in existing conduit, handholes and cabinets, or new conduit and handholes installed by the Paren (452) project. The Contractor shall be aware that the project plans show existing conduit infrastructure which may not yet have been installed after the award of this contract. The Contractor shall schedule work to account for civil infrastructure projects installing conduit, hand holes and other appurtenances necessary to complete the work of this contract.

The Contractor shall provide the Engineer any requests to perform work during the dates of special events a minimum of five (5) calendar days prior to the event. The decision of the Engineer regarding a request will be final.

C. Building Facilities

All work in or around any building facility shall be coordinated with the Engineer and the Iowa DOT District staff. Provide a minimum of 48 hours notice to the Engineer before performing any work in the immediate vicinity of a building or surrounding parking area.

1.3 Contractor's Responsibility

A. Coordination with Utilities

1. The Contractor is responsible for determining the exact location and elevation of all public utilities in proximity to any construction work and shall conduct all activities to ensure that public utilities are not disturbed or damaged.

2. The Contractor is fully liable for all expenses incurred as a result of failing to obtain required clearances, location of utilities, and any damage to utilities caused by construction.

3. Utility companies whose facilities are shown on the plans or known to be within the construction limits shall be notified by the Contractor of the starting construction date.

B. One Call Locating

Until final acceptance, the Contractor shall provide all utility locates of the work performed under this contract when requested through One-Call services or by the Engineer. The Contractor shall perform any such locations within forty-eight (48) hours of receiving notice that such locations are needed.

C. Material and Equipment Storage and Construction Site Access

1. Contractor shall secure a designated material storage area for this project. Any request to store material in the right-of-way in order to complete the current work activity shall be approved by the Engineer.

2. Construction equipment may be stored within the right-of-way during non-working hours if it is outside of the roadway clear zone, as far from the traveled way as practical and as approved by the Engineer. No equipment shall be stored at the toe of any roadway slope.

3. No worker vehicles will be allowed to park in, or access a job site directly from an Interstate or Freeway facility. Access to the job site for both workers and materials shall only be via interchanges or intersecting roadways unless otherwise approved by the Engineer. Worker vehicles shall be parked off-site or at a location acceptable to the Engineer

D. Finishing Activities

Upon completion of the work at each project area, thoroughly clean the site and restore it to a condition at least equal to that existing prior to construction. Project area is defined as the approximate area disturbed during a normal week of work. During and after completion, employ appropriate measures for erosion control, where applicable. Seed and fertilize work areas upon completion of work in accordance with the Contract Documents.

1.4 Disruption to Existing Fiber Networks

A. Planned Disruption

The Contractor shall ensure continuous operation of the existing fiber networks and systems during construction of the project. The Contractor shall be responsible for repairing, to Iowa DOT's satisfaction and at no cost to Iowa DOT, any damage the Contractor causes to the existing fiber networks and systems during the life of the project.

The Contractor shall not work on splicing, disconnecting and/or in any way disrupting normal operation of the existing fiber networks or systems without approval from all affected parties. Parties include the Iowa DOT, the City of Council Bluffs and the Iowa Communications Network (ICN). The Contractor shall provide a written request to the Iowa DOT and the respective parties for approval at least 10 calendar days before the existing fiber network or equipment is disrupted. A copy of the written request shall be submitted to the Engineer in all cases. In addition to the written request, the Contractor shall submit the work plan and schedule for approval by the Engineer. The work plan shall include all fiber strands and the parties being affected.

The Contractor shall restore the disrupted system upon completion of the Work within the allowable working hours. The Contractor shall remain on site until Iowa DOT notifies that the disrupted systems are fully operational. Failure of the Contractor to restore disrupted systems and equipment within the allowable working hours will constitute an unplanned disruption.

B. Allowable Working Hours

The Contractor shall only disrupt existing fiber according to the allowable working hours as follows.

1. Iowa DOT, ICN and City of Council Bluffs IT

Disruptions to the existing systems shall only occur between Midnight and 6:00 AM on working days unless otherwise approved by the Engineer.

2. City of Council Bluffs Traffic Signal

Disruptions to the traffic signals shall be limited to no more than 7 Calendar days.

C. Unplanned Disruption

Any unplanned disruptions determined by the Engineer to be caused by the actions of the Contractor shall be corrected by the Contractor at no additional cost to Iowa DOT.

In the case of an unplanned disruption and subsequent notification by the Engineer, the Contractor shall immediately stop all other work in progress and shall expend all of its efforts to restore the disrupted system(s) or correct the problem causing the disruption. The Contractor will not be granted an extension of time for delays caused by repairing disrupted systems. Unplanned disruptions shall result in the assessment of liquidated damages.

D. Liquidated Damages

Unplanned disruptions to the existing fiber optic network will result in impacts to the traveling public, increase fuel consumption, vehicle operating costs, pollution, and time needed for Iowa DOT administration, engineering, inspection, and supervision, and other inconveniences and harm far in excess of those resulting from delay of most projects.

Accordingly, the Contractor agrees:

1. To pay $250.00 liquidated damages per 15 minutes for each 15 minute period that the Contractor fails to restore the proper operation of an existing fiber optic network element following an unplanned disruption.

2. To authorize the Engineer to deduct these liquidated damages from any money due or coming due to the Contractor.

1.5 Contractor Submissions

A. Materials List

The Engineer will furnish a list of materials required for the project to each bidder with the Request for Proposal (RFP). The Contractor shall complete and submit one (1) electronic pdf file of the materials list within seven (7) calendar days after award of the contract. Include the name of the materials supplier and catalog number of each item listed.

B. Construction Schedule

1. Within 30 calendar days after award of contract, the Contractor shall submit to the

Engineer one (1) electronic pdf file of the detailed construction schedule including dates of commencement for each major work item, duration of each major work item and completion of each major work item on each segment and phase of the proposed construction.

2. Major items of work to be included on the schedule shall include, but is not limited to the following:

a. Duration of fiber optic cable procurement
b. Duration and location of site preparation and staging
c. Duration and location of fiber optic cable installation
d. Duration and location of fiber splices and terminations with the exception of connection to the existing system,
e. Duration and location of fiber testing required and submission of the test report.
f. Submission of a fiber cut-over plan and schedule for connection to the existing fiber optic network and at each existing device locations including ITS, traffic signals, and fiber termination cabinets.
g. Duration and location of fiber cut-over
h. Submission of final test report.

3. Fiber cut-over plan and schedule shall be submitted to the Engineer and all affected parties for approval at least fourteen (14) calendar days prior to the final cut-over.

4. The Engineer will review and accept or reject the schedule within seven (7) calendar days after the submission of the schedule. In the event of rejection, the Contractor shall re-submit the updated schedule within seven (7) calendar days of notification from the Engineer.

5. Upon acceptance of the schedule, the Contractor will be expected to adhere to these dates as proposed unless modified with the approval of the Engineer.

6. Submittal and approval of the proposed construction schedule by the Engineer is required before the Contractor can commence construction activities.

C. Shop Drawings/Catalog Cuts

1. Prior to construction and after approval of the Materials List, the Contractor shall submit one (1) electronic pdf file of the shop drawings or catalog cuts for the materials to the Engineer for approval.

2. The Engineer shall review the shop drawings/catalog cuts for the purpose of assuring general conformance with the project design concept and Contract Documents. The Engineer will provide approval or rejection of shop drawings within fourteen (14) calendar days of the Contractor’s submission. The Contractor shall re-submit the shop drawings for approval within seven (7) days of the Engineer’s rejection.

3. The Contractor shall provide written notice of any deviations from the requirements of the plans or Contract Documents.

4. Engineer's approval of shop drawings/catalog cuts does not relieve the Contractor of responsibility for providing satisfactory materials complying with the Contract Documents. Errors not detected during review do not authorize the Contractor to proceed in error.

D. Materials Procurement

1. Shop drawings, specification data, and samples for acceptance testing (when requested) shall be submitted to the Iowa DOT for approval and/or selection prior to the placing of orders for any equipment and materials.

2. The Contractor shall order all materials requiring production lead time greater than 4 weeks within seven (7) calendar days of receiving the approved shop drawing(s).

3. The Contractor shall submit to the Engineer proof of material purchase order in electronic pdf format.

E. Final Acceptance

1. The Contractor shall perform all the obligations under the contract before the final acceptance of the project by Iowa DOT. The final acceptance is anticipated date of March 31st, 2015. Completion of the work will be the date of approval and work acceptance on "Statement of Completion and Final Acceptance of Work" (Form 830435) by the Engineer. Warranty begins on this date on the final acceptance form.

2. Final acceptance shall not constitute acceptance of any unauthorized or non-compliant Work or material. Iowa DOT shall not be barred from requiring the Contractor to remove, replace, repair, or dispose of any Work or material that is defective, unauthorized or that otherwise fails to comply with the Contract Documents or from recovering damages for any such Work or material.

3. Final acceptance shall not relieve the Contractor of any obligations and/or responsibilities relating to warranty requirements designated in the Contract Documents.

F. Warranty

1. The Contractor shall transfer all required standard materials warranties on the date of final acceptance to the Iowa DOT.

2. Materials warranty periods shall not commence prior to final acceptance of the Work, and shall remain in effect until at least one year after the final acceptance for all cables and equipment furnished and installed for this project.

3. The Contractor shall provide a minimum of one year workmanship warranty after the final acceptance of the Work. The workmanship warranty shall consist of an assurance by the Contractor that the Work is free of defects, conforms to professional engineering principles in the State of Iowa, and meets the requirements of the Contract Documents in which the Contractor agrees to repair or replace Work or items that are defective or do not meet the requirements of the contract during the workmanship warranty period.

4. At any time during the workmanship warranty period, if Iowa DOT determines that any of the Work has not met the standards set forth in the contract, then the Contractor shall correct the Work without additional cost to Iowa DOT, even if the performance of such correction extends beyond the workmanship warranty period.

5. Within seven (7) calendar days of receipt of notice from Iowa DOT specifying a failure of any work required to satisfy the workmanship warranty, the Contractor shall respond to Iowa DOT and shall mutually agree when and how the Contractor shall remedy such failure. In the event of an emergency requiring immediate action, the Contractor shall

implement such immediate action it deems necessary and shall notify Iowa DOT of the urgency of a mutually agree-upon remedy. If the Contractor does not use its best efforts to proceed to effectuate a remedy within 7-day period, or immediately in the case of emergency conditions, Iowa DOT, upon notice to the Contractor, will have the right to order the Contractor to perform the work, or to perform or have performed by others the remedy approved by Iowa DOT, and the cost shall be paid by the Contractor.

1.6 As-Built Documentation

A. General

1. As-built record drawings will be the responsibility of, and completed by, an on-site representative of the Engineer. As such, it will be the responsibility of the Engineer's representative to coordinate directly with the Contractor to ensure that a master record set of the plans is maintained throughout construction to document all installations and any deviations from the design shown in the Contract Documents.

2. It is the responsibility of the Contractor to maintain written records of daily construction progress, areas worked and quantities installed to aid in the completeness of as-constructed documentation by the Engineer's on-site representative.

B. GPS Data Recording Staking Assistance

1. The Engineer's on-site representative will be responsible for collecting GPS data of all installations including, but not limited to: conduit routing, handholes, device poles, device cabinets, and power supplies. All efforts will be made by the Engineer's on-site representative to coordinate with the Contractor and collect construction progress daily.

2. The Contractor shall be responsible to coordinate and assist the Engineer's on-site representative in this effort by staking, flagging or otherwise locating all installed features until such time that the GPS data can be collected.

1.7 Charging of Working Days

A. Definition

1. A working day will be considered to be any calendar day, exclusive of Sundays, a recognized legal holiday, or any other dates specifically noted in the Contract Documents on which weather or other conditions (not under control of the Contractor) will permit construction operations to proceed for not less than 3/4 of a normal work day in the performance of any major item of work. Major items of work shall be determined by the Contractor's approved schedule.

2. Saturdays will be considered a working day under this contract.

B. Determination

The Engineer shall determine if a day is considered a working day. Work is permitted at any time the Contractor determines that the work completed will be in compliance with the Contract Documents, subject to any limitations stated in the Contract Documents.

PART II
TECHNICAL PROVISIONS

This part consists of the material requirements, construction details, and methods of measurement and basis of payment necessary to complete construction of the fiber deployment project, in place, as described in the Contract Documents.

2.1 General

1. Supply only new materials from reputable suppliers and manufacturers approved by the Engineer. Provide any items, equipment, or materials not specifically addressed in the Contract Documents but required to provide a complete and functional installation. The level of quality shall be consistent with other specified items. All miscellaneous electrical equipment and materials shall be UL-approved. Securely store and protect all materials delivered to the project site. Provide appropriate material quantities for testing or verification at no additional cost when requested by the Engineer.

2. The Contractor shall expect some reasonable variation in location of the facilities shown due to unforeseen conflicts, changes in proposed work, installation difficulties, or other circumstances. The Engineer shall authorize any changes in location in writing before performing the installation. No additional compensation shall be provided for additional work associated with or resulting from unauthorized changes to the Contract Documents.

3. The Engineer shall authorize any changes in location in writing before performing the installation. No additional compensation shall be provided for additional work associated with or resulting from unauthorized changes to the Contract Documents.

2.2 Traffic Control

All traffic control on this project shall comply with Article 2528 of the Standard Specifications and the Contract Documents.

A. Materials

1. Use materials meeting the requirements of Part 6 of the MUTCD and Division 41 of the Standard Specifications for the respective traffic control signs and devices.

2. All signs for traffic control zones shall be mounted and maintained on Iowa DOT approved moveable skids, or other approved method, regardless of expected duration.

B. Construction

1. The contractor shall notify the local Iowa DOT Maintenance Shop and the Iowa DOT Traffic Operations Center, preferably 10 calendar days in advance, but at a minimum 48 hours in advance, of any width or height restrictions on the primary highways.

2. The Engineer shall provide any required detour routes and detour route signage at no cost to the Contractor. All lane, ramp, and roadway closures are subject to the limitations stated in the Contract Documents and the approval of the Engineer. Request any such closures a minimum of ten (10) calendar days prior to the desired

closure date in accordance with Article 1108.02M of the Standard Specifications. The decision of the Engineer regarding a request shall be final. Closures of convenience will not be permitted.

3. The Contractor shall maintain daily, and submit when requested, an Iowa DOT traffic control monitor checklist and diary. Found at: http://www.iowadot.gov/construction/traffic_safety/tc_monitor_wz_checklist.xls

4. The Engineer will resolve all conflicts.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for traffic control shall be paid for at the lump sum contract unit price bid for the pay item "Traffic Control".

2. Payment is full compensation for:

- Erecting, maintaining, moving, and removing all traffic control devices required by the Contract Documents, including warning lights,
- Furnishing all materials, labor, equipment, and other items associated with all work zone traffic control necessary to meet the requirements of the Contract Documents, and
- Traffic quality control.

3. The Engineer reserves the right to issue partial payment of this lump sum item based upon the estimated percentage of work completed as determined by the Engineer.

2.3 Mobilization

All mobilization on this project shall comply with Article 2533 of the Standard Specifications and the Contract Documents. Mobilization may include bonding, permit, and demobilization costs.

A. Materials
None

B. Construction
None

C. Method of Measurement & Basis of Payment

1. Measurement and payment for project mobilization shall be paid for at the lump sum contract unit price bid for the pay item "Mobilization".

2. Payment is full compensation for all preparatory work and operations for all items under the contract, including, but not limited to those necessary for:

- The movement of personnel, equipment, supplies, and incidentals to the project site,
- The establishment of all offices, buildings, and other facilities necessary for work on the projects, and
- All other work operations which shall be performed or costs incurred prior to beginning work on the various items on the project site.

3. The Engineer reserves the right to issue partial payment of this lump sum item per the stipulations of Article 2533.05, A of the Standard Specifications.

2.4 Wire and Cable

A. Materials

1. Tracer Wire

Single conductor, stranded copper, Type THHN, No. 12 AWG with UL approval and orange colored jacket.

B. Construction

1. General

a. All installations and connections shall comply with the Contract Documents and all generally accepted codes and standards.

b. Install cable connectors in accordance with Standard Road Plan RM-40 and the Contract Documents at the base of all breakaway poles, cabinets, or other installations for all non-low voltage installations unless otherwise directed by the Engineer. All costs associated with these connectors are incidental to the cost of the connected items of work.

c. The Engineer will resolve all conflicts.

2. Tracer Wire

a. Where existing tracer wire is found, the Contractor has the option to either pull new fiber optic cable over the existing tracer, or remove and reinstall the existing tracer. For either case, the Contractor shall perform continuity tests before and after the fiber installation to confirm that the tracer wire was not damaged, and submit test results to the Engineer for approval. If damaged, the Contactor shall replace or repair as necessary at no cost to the Iowa DOT.

b. Where new tracer wire is installed, the Contractor shall:

- Splice tracer wires in the Fiber Vault, handholes, cabinets, and pole bases to form a continuous network using splice kits UL tested for wet locations.
- Terminate each tracer wire run at Type Fiber Vault handholes in test stations.
- Maintain the continuity of the tracer wire through Type FOR27 pulling handholes.
- Test all tracer wire for continuity. Submit test results to Engineer for approval.

c. Labeling Requirement

- Place tags on all fiber optic cable identifying the owner and direction of the cable at each termination point and in every handhole, Fiber Vault, and cabinet.
- Tags shall clearly identify where each individual cable run originated and where it ends (handhole to handhole, handhole to cabinet, handhole to building, etc.)

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all new trace wire shall be paid for at the contract unit price per linear foot for the pay item, “Tracer Wire” (Testing, removal, reinstallation, and repair of existing tracer wire is not a separate pay item. Include costs in the

price bid for the Fiber Optic Cable items.)

2. Payment is full compensation for:
- The furnishing, installation and testing of all wire and cable,
- Including the proper installation of the wire and cable into existing conduit and new conduit systems, supply and installation of splices and connectors, and slack, coiled, or stored wires or cables, and
- Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the Contract Documents.

2.5 Fiber Optic Cable

A. Materials

1. General

a. The cable shall meet the latest applicable standard specifications by American National Standards Institute (ANSI), Electronic Industries Association (EIA) and Telecommunications Industries Association (TIA) for the single-mode fiber cable of the size specified per the Plans.
b. All fiber optic cable for installation on this project shall be provided by the Contractor.

2. Single-mode Fiber Optic OSP Cable – Dielectric Loose Tube

a. Fiber optic, single-mode, graded loose tube dielectric cable constructed with industry standard 3mm buffer tubes stranded around a central strength member.
b. The buffer tubes shall be compatible with standard hardware and shall have 12 fibers per tube, the fibers shall not adhere to the inside of the buffer tube, each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598-B and be colored with ultraviolet (UV) curable ink.
c. The cable core shall be water blocked with dry water blocking materials to improve access and handling of individual tubes.
d. The cables shall be designed for point-to-point applications as well as mid-span access, and provide a high-level of protection for fiber installed in the outside plant environment.
e. Single-mode, dispersion-unshifted fiber meeting ITUT G.652D requirements.
f. The fiber shall be fully capable of handling existing and legacy single-mode applications which traditionally operate in the 1310 nm and 1550 nm regions and shall also be designed to operate the full-spectrum from 1260 nm to 1625 nm for optical transmission.
g. The fiber shall be designed to provide optimum performance from 1260 nm to 1625 nm intended for 16-channel Course Wavelength Division Multiplexing applications.
h. Cables shall be sheathed with medium density polyethylene (MDPE). The minimum nominal jacket thickness shall be 1.3 mm. Jacketing material shall be applied directly over cable core and water swellable tape. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.
i. The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C, Category 4 and Grades J4, E7 and E8.
j. The jacket or sheath shall be free of holes, splits, and blisters.
k. The cable jacket shall contain no metal elements and shall be of a consistent thickness.
l. Cable jackets shall be marked with the manufacturer's name, month and year of manufacturer, sequential meter or foot markings, a telecommunication handset

symbol as required by Section 350G of the National Electrical Safety Code (NESC), fiber count, and fiber type. The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white, with the exception that cable jackets containing one or more coextruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 2.5 mm.

m. The maximum pulling tension shall be 2700 N (600 lbf) during installation (short term) and 890 N (200 lbf) long term installed.
n. The shipping, storage, and operating temperature range of the cable shall be -40°C to +70°C. The installation temperature range of the cable shall be –30°C to +70°C.

B. Construction

1. **General**
   a. Remove fiber optic cable from the reel in a manner acceptable to the Manufacturer and Engineer.
   b. Install fiber optic cable in existing conduit as indicated in the Contract Documents.
   c. Direct bury of fiber optic cable is not allowed.
   d. Do not twist or bend the fiber optic cable in excess of the limits recommended by the manufacturer.
   e. As the cable is fed into the duct and conduit system the Contractor shall use a manufacturer approved water-based cable lubricant for all fiber optic cable installations.
   f. Protect at all times all proposed cables, cable ends, and any exposed portions of fiber optic cable from damage including water intrusion.
   g. Any existing pull tape or tracer wire that is used as a pull rope for fiber optic cable installation shall be replaced in kind. The cost of any tracer wire or pull tape replacement shall be subsidiary to the fiber optic cable installation.

2. **Cable Installation**
   a. All fiber optic cable shall be installed in conduits.
   b. A suitable cable feeding method shall be used between the cable reel and the face of the duct and conduit to protect the cable and guide it into the duct.
   c. Dynamometers and breakaway pulling swings shall be used to ensure that the pulling line tension does not exceed 600 pounds (2668 N).
   d. The mechanical stress placed on a cable during installation shall not be such that the cable is twisted or stretched. A pulling eye and swivel shall be attached to the cable and used to install the cable through the duct conduit system to prevent the cable from twisting.
   e. Cables shall not be forced around sharp corners and precautions shall be taken during installation to prevent the cable from being kinked or crushed.
   f. Minimum bending radius during installation shall not be less than twenty (20) times the outside diameter of the cable or as recommended by the manufacturer, whichever is greater.
   g. Pulling of the cable shall be hand assisted.
   h. DOT approved installation methods include Pulling, High Air Speed Blowing, Air- Assist, Push/Pull Installation, and Air Blown Cable. Installation shall comply with all manufacturers' recommendations for cable installation including pulling tensions and bending radii.
   i. The cable shall be carefully inspected for jacket defects. If defects are noticed, the pulling operation shall be stopped immediately and the Engineer notified. The Engineer shall make a determination of acceptability or shall reject the cable.
   j. The fiber cable shall be installed in continuous runs as marked on the plans. End

of reel splices or butt splices not shown in the plans shall be pre-approved by the Engineer and are incidental to the cost of the installation of the cable. If approved, the end of reel or butt splices shall be performed in existing splice vaults as shown on the plans. The cost associated with the end of reel or butt splices including splice closures, storage baskets, splice trays, protective sleeves, and all accessories shall be included in their respective items and shall not result in additional cost to Iowa DOT.

k. No splices shall be allowed unless indicated by the plans or approved by the Iowa DOT.

l. Seal all conduit openings using an approved sealing compound (duct seal) at all conduit openings at the junction boxes handholes, poles, cabinets, and building entrances after cable installation.

3. **Facilities Protection**
   a. In the event it is suspected that cable damage has occurred by the Engineer prior to final acceptance, Contractor shall test the cable with an OTDR within seventy two (72) hours after notification and submit a copy of the OTDR test to the Engineer upon completion.
   b. Contractor shall replace or repair, as directed by the Engineer, any damage occurring before final acceptance at no additional cost to the Iowa DOT. Perform any repairs or replacements as soon as reasonably possible unless otherwise approved by the Engineer.
   c. Contractor shall repair or replace any defect in the installed cable at no additional cost to the Iowa DOT. Consider a defect to be any condition resulting in a negative or adverse effect on current or future operations of the completed fiber optic communication system as determined by the Engineer.
   d. Any existing wiring that is damaged during fiber optic cable installation shall be replaced or repaired, as directed by the Engineer, at no additional cost to the Iowa DOT.

4. **Slack Coils**
   a. Sufficient slack shall be left at each end of the cable to allow proper cable splicing and termination. The minimum slack amount shall be as follows or as indicated in the plans:
      - Handhole, type FOR27 – 60 feet per cable without splicing
      - Handhole, type Fiber Vaults – 150 feet (75 feet per each end of the cable)
   b. Storage of slack cable in cabinets and handholes shall be neatly coiled. The slack coils shall be bound at a minimum of three (3) points around the coil perimeter. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames and terminals.
   c. For storage purposes, the minimum bending radius shall not be less than ten (10) times the outside diameter of the cable or as recommended by the manufacturer, whichever is greater.

5. **Cable Identification**
   a. Place tags on all fiber optic cable identifying the owner and direction of the cable at each termination point and in every handhole, Fiber Vault, and cabinet.
   b. Tags shall clearly identify where each individual cable run originated and where it ends (handhole to handhole, handhole to cabinet, handhole to building, etc.)
   c. For fiber installations with joint Department of Transportation/other agency (or entity) use where the fiber will be owned by the other agency (or entity), install typical identifiers and/or markings for that fiber.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all fiber optic cable shall be paid for at the contract unit price per linear foot for the pay items “144 SM Fiber”, “96 SM Fiber”, and “12 SM Fiber”, “Reinstall Existing 12 SM Fiber”, and “Reinstall Existing 96 SM Fiber”.Payment is full compensation for:
    a. The furnishing and installation of all cables and wires per the Contract Documents,
    b. Furnishing all materials, labor, tools, consumable items and other incidental items necessary to meet the requirements of the Contract Documents.

2.6 Fiber Optic Cable Accessories and Hardware

A. Materials

1. Single Panel Housing (Holds 1 Connector Panel and Splice Organizer)

- **a.** Surface mounted termination/splice housings shall provide for termination capabilities, splice protection, and associated fiber/pigtail storage.
- **b.** Surface mount housing shall be intended for splicing and management, and cross- connect or both for up to 12 fibers.
- **c.** Termination adapter panels shall be duplex SC
- **d.** Top and bottom cable entry grommets for incoming fiber, fiber jumper.
- **e.** Manufactured of metal.
- **f.** Hinged front door, universal mounting brackets, jumper bend limiters, labels for identifying fiber terminations.
- **g.** Wall mountable single panel housing shall be Corning SPH-01P and CCH adaptor panel, or approved alternate.

2. SC Connector Adaptor Panels

- **a.** Termination adapter panels shall be duplex SC
- **b.** Adaptor panels should be the same manufacturer as the panel housing.

3. UPC/SC Factory Terminated Fiber Connector and Pigtails (Include Splice and Connector Sleeve)

- **a.** All fiber connectors used on this project, including in shelves, cabinets or panels, shall be factory installed connectors.
- **b.** No field terminated connectors will be allowed.
- **c.** Connectors shall be SC/UPC having a typical insertion loss (single-mode) of 0.15 dB or less, a maximum loss of 0.35 dB or less, with typical reflectance of -55 dB, and temperature stability from -40 degrees C to 75 degrees C.
- **d.** Fiber used for pigtails shall be of the same manufacturer as the main fiber cable.
- **e.** Pigtails shall be rated for the environment they are installed in.
- **f.** Pigtails shall be spliced in accordance with the splicing specifications and in fiber shelves or panels using manufacturer splice organizers.

4. Outside Plant (OSP) Fiber Splice Closures

- **a.** Supply environmental protection of cable and splices from water and dirt and that is designed to be submersed in water and installed underground outside plant use for splicing fiber optic cables in handholes.
- **b.** The splice closure shall be compatible with all sizes of fiber cables used on this project and large enough to accommodate the number of splices plus an additional 10% at

locations where splices (including splices required for the future) are shown on the plans.

c. The closures shall be a dome type splice closure manufactured from a high density polyethylene or approved alternate nonmetallic material with the following properties:

- Cable entry shall be manufactured of similar material to the dome body and shall seal the closure with re-usable compressed gel cable sealing components that accommodate a wide range of cable sizes.
- Closures shall be re-enterable and re-sealable without the need for specialized tools or equipment or any additional parts.
- No encapsulated materials shall be allowed.
- Be provisioned for a minimum of six cable port entries. Each cable port entry shall be able to accommodate multiple drop cables using the appropriate sealing kits.
- Hinging splicing trays that provide controlled access to splices and slack storage.
- Splice and storage compartments accessible via a removable dome-clamp system.
- The closure shall allow for the storage of at least eight unopened buffer tubes.

d. The splice closure shall contain all splice trays, storage, splice sleeves, organizing materials, and any other incidental materials required to complete the splices at the locations shown in the plans.

e. After splicing is complete, the fiber optic cable and closure shall be flash tested for leaks.

f. The splice closure shall be TYCO Model FOSC450 series, or approved alternate.

B. Construction

1. Fusion Splices

a. Fusion splices shall be used to splice all continuous fiber runs in splice closures and factory terminated connector pigtails.

b. Splices shall be allowed only in the splice closures as shown on the plans.

c. Maximum attenuation per splice as estimated by the fusion splicer shall not exceed 0.08 dB. Any splice exceeding 0.08 dB at the time of splicing shall be re-spliced.

d. Splice shall provide three axis core alignment using light injection and loss measurement techniques.

e. No mechanical splices of fiber cable will be allowed.

f. All fusion splice equipment shall be factory certified within the last year. The Contractor shall provide copies of the certification 10 calendar days prior to splicing.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all fiber optic cable accessories and hardware shall be paid for at the contract unit price per each for the pay items “Single Panel Housing (Holds 1 Connector Panel With Splice Organizer)”, “6 Duplex SC Connector Adaptor Panel”, “UPC/SC Factory Terminated Fiber Connector and Pigtails (Include Splice & Protector Sleeve)”, “Fiber Optic 12 Splice Tray”, “Fiber Optic 24 Splice Tray”, “Fiber Optic Splice (With Protector Sleeves)”, and “Fiber Optic Splice Closure (With Storage Baskets)”,

2. Payment is full compensation for:

a. The furnishing and installation of all fiber optic cable accessories and hardware per

the Contract Documents,

b. Furnishing materials, labor, tools, splicing equipment, consumable items, and incidentals necessary to install all required fiber accessories and hardware, access any existing splice closures, and perform quality fiber splicing and terminations to meet the requirements of the Contract Documents.

2.7 Locate Box

A. Materials

1. General

a. The Contractor shall provide an outdoor-rated station protector on the outside of traffic controller cabinets.

b. The Contractor shall run a ground wire to the main ground breaker of the traffic controller and run the fiber locate wires to the pedestals in the station protector. All tracer wires shall be interconnected to the ground post.

c. Locate box shall be TII 349-2LG or approved alternate.

B. Construction

1. General

a. The box shall be mounted to the exterior of the signal cabinet.

b. A ground wire shall be attached to a lug within the box from the signal cabinet.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all locate boxes shall be paid for at the contract unit price for the pay item “Fiber Locate Box”.

2. Payment is full compensation for:

a. The furnishing and installation of all locate boxes as shown in the Contract Documents.

b. Furnishing all materials, labor, equipment, and other incidental items including supply and installation of cable as necessary to meet the requirements of the Contract Documents.

2.8 Removal Items

The Contractor shall remove items as indicated on the Plans. Unless otherwise specified on the plans, the removal items shall become the property of the Contractor. The Contractor is responsible for salvaging and/or disposal of the material. All costs incidental to the removal of these items shall be included in the respective pay items.

A. Method of Measurement & Basis of Payment

1. Measurement and payment for all removal items shall be paid for at the contract unit price per units indicated in the Table of Quantities in the Plans for the pay items “Remove Existing Fiber Interconnect Cabinet”, “Remove Existing Splice Closure”, “Remove Existing 12 SM Fiber”, and “Remove Existing 96 SM Fiber”.

PART III
ACCEPTANCE CRITERIA

3.1 Fiber-Optic Cable Acceptance Testing

A. Materials
None

B. Construction

1. Fiber Optic Cable Acceptance Testing

a. The Contractor shall submit the following documents to the Engineer for approval at least fourteen (14) calendar days prior to the acceptance testing.

- Fiber test plan and schedule
- Fiber cut-over plan and schedule
- Final test plan and schedule

b. The Contractor shall perform all testing and the fiber cut-over with the presence of the Engineer or the Engineer's representative(s)..

c. Post installation, one hundred percent (100%) of the new cables' fiber count shall be tested bidirectionally with an Optical Time Domain Reflectometer (OTDR) at 1310 nm and 1550 nm; in addition, an Optical Loss Test Set (OLTS) shall be used to test all fibers at both wavelengths. Existing fibers that are spliced to or re-spliced as part of this contract shall also be tested in both directions and at both wavelengths. The Contractor shall provide the Engineer with up to five copies of any software required for viewing electronic files of the OLTS and OTDR traces. Use test equipment or alternate to EXFO FTB-500 OTDR meter, and Fluke DTX-CLT OLTS meter.

d. All test equipment shall be factory certified within the last year. The Contractor shall provide copies of the certification 10 days prior to testing.

e. Test results will be recorded on a form supplied by the Contractor, with data compiled in .PDF format through the meter manufacturer's software. No additional alteration using software from the Contractor beyond the meter manufacturer's software will be allowed. The Contractor shall submit test results in a format approved by the Engineer. Completed test forms on each fiber shall be handed over to the Engineer. Contractor shall also provide native test (electronic version) with no alterations and meter software for viewing of fiber traces. At a minimum, test results shall show the following:

- Cable and fiber identification (as approved by Iowa DOT)
- Operator name
- Date and Time
- Setup and test parameters including wavelength, pulse width, range, scale and ambient temperature.
- Test results for OTDR test in both directions for total fiber trace, splice loss/gain (dB), connector loss (dB), all events greater than .05 dB, measured length from cable markings and total length from OTDR.

- Test results for attenuation test including measured cable length (cable marking), total length (from OTDR test), number of splices (from as-built) and total link end-to-end attenuation in each direction and the bidirectional average.

f. OTDR testing shall use launch and receiving cables minimum 1000 meters or greater than the dead zone for the OTDR used for this test.

g. All fiber connectors shall be cleaned and checked for dirt, scratches or chips before installed in adapters and testing. All dust covers shall be installed after testing is complete.

h. The Contractor shall test all fibers installed prior to the fiber cut-over to the existing fiber network and connect to the existing devices. The test results shall be submitted to the Engineer for approval prior to the fiber cut-over.

i. The Contractor shall verify prior to submittal to the Engineer for approval that all test results satisfy the requirements of the Contract Documents.

j. The Contractor shall provide the Engineer a minimum of four (4) weeks to review the test results.

k. All test results submitted to the Engineer by the Contractor are subject to reduced compensation if the test results are identified as Out of Specifications (OOS) detailed below:

- The fiber optic cable shall have a maximum attenuation of 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm when measured with an OLTS. Fiber test results submitted to the Engineer that exceed the max attenuation loss specification will be identified as OOS and shall result in reduced compensation of $150.00 for each OOS trace.

- Each connector shall have an averaged loss value of 0.25 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm. Connector test results submitted to the Engineer that exceed the max loss of 0.50 dB in a single direction or an average bi-directional loss of 0.25 dB will be identified as OOS and shall result in reduced compensation of $150.00 for each OOS trace.

- Each splice shall have an averaged loss value of 0.08 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm. Splice test results submitted to the Engineer that exceed the 0.08 dB will be identified as OOS and shall result in reduced compensation of $150.00 for each OOS trace.

l. In the event of OOS, the Engineer will reject the test and notify the Contractor to retest. The Contractor shall remove malfunctioning units, replace with new units, and retest meeting the requirements specified above. The Contractor shall submit the test results for the Engineer's approval.

m. The Contractor shall not begin the fiber cut-over without the approval of the fiber test results and the fiber cut-over plan from the Engineer and all parties involved. The fiber cut-over shall be performed within the allowable working hours

specified in the Contract Documents.

n. Upon completion of the final cut-over, the Contractor is required to perform final OTDR and OLTS tests as follows.

- The OTDR test shall provide bidirectional measurements of each of the fiber splices and terminations occurred during the final cut-over in accordance with the requirements specified above. The OTDR test result shall be submitted to the Engineer for approval.

- The OLTS test shall measure the end-to-end attenuation of each new and existing fiber installed between a field device and a fiber termination location in the fiber termination cabinets, Iowa DOT and the City of Council Bluffs facilities, and between these facilities. These facilities include Iowa DOT North Maintenance Garage, Iowa DOT South Maintenance Garage, the City of Council Bluffs Fleet Maintenance Garage, and the City of Council Bluffs Library. The test shall be performed in the 1310 and 1550 nanometer wavelengths. The OLTS test results shall be submitted to the Engineer for record.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for fiber optic acceptance testing shall be paid for at the lump sum contract unit price bid for the pay item “Fiber Optic Acceptance Testing”.

2. Payment is full compensation for:
- **a.** The furnishing of all test equipment
- **b.** Furnishing labor, tools, testing equipment, consumable items, and incidentals necessary to complete all acceptance testing satisfying the requirements of the Contract Documents.

PART IV
ADDITIONAL BIDDING ATTACHMENTS

4.1 Equipment and Materials List

Iowa DOT PROJECT NO. IMN-029-3(150)54--0E-78 IN COUNCIL BLUFFS, IOWA

DESCRIPTION	MANUFACTURER	CATALOG NUMBER
TRAFFIC CONTROL		
MOBILIZATION		
6 DUPLEX SC CONNECTOR ADAPTOR PANEL		
FIBER OPTIC 12 SPLICE TRAY		
FIBER OPTIC 24 SPLICE TRAY		
FIBER OPTIC SPLICE (WITH PROTECTOR SLEEVES)		
FIBER OPTIC SPLICE CLOSURE (WITH STORAGE BASKETS)		
LOCATE BOX		
REMOVE EXISTING FIBER INTERCONNECT CABINET		
REMOVE EXISTING SPLICE CLOSURE		
SINGLE PANEL HOUSING		
UPC/SC FACTORY TERMINATED FIBER CONNECTOR PIGTAILS		
12 SINGLE MODE FIBER OPTIC CABLE		
96 SINGLE MODE FIBER OPTIC CABLE		
144 SINGLE MODE FIBER OPTIC CABLE		
REINSTALL EXISTING 12 SM FIBER		
REINSTALL EXISTING 96 SM FIBER		
TRACER WIRE		
FIBER OPTIC ACCEPTANCE TESTING		